

# ***The NASA Clinic System***

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# ***NASA Medical Care***



Underwater...

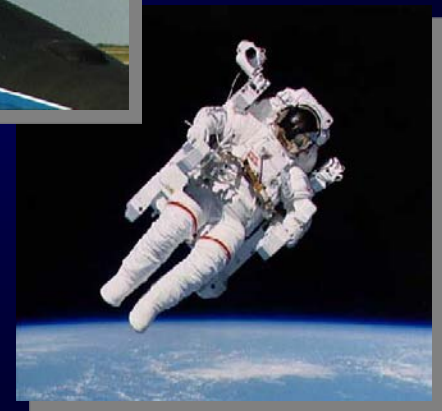


..on the ground...

...through the air...



...and into space



# Authority for NASA Health Care: Occupational Health

## ◆ 5 USC 7901

- The head of each agency of the Government of the United States may establish, within the limits of appropriations available, a health service program to promote and maintain the physical and mental fitness of employees under his jurisdiction.
- A health service program is limited to
  - (1) treatment of on-the-job illness and dental conditions requiring emergency attention;
  - (2) pre-employment and other examinations;
  - (3) referral of employees to private physicians and dentists; and
  - (4) preventive programs relating to health.

# Authority for NASA Health Care: Astronaut Health

## ◆ 31 USC 1301(a)

- Appropriations shall be applied only to the objects for which the appropriations were made except as otherwise provided by law.

## ◆ US General Accounting Office, Principles of Federal Appropriations Law (the GAO Red Book)

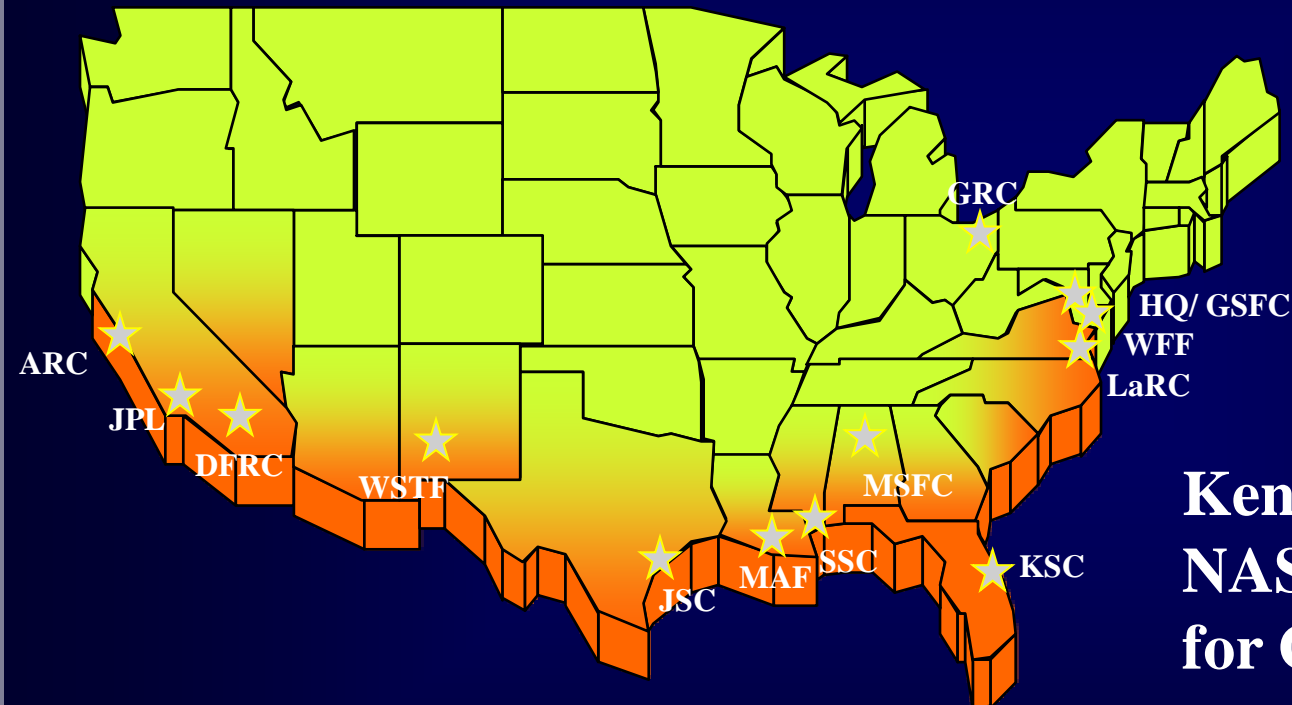
- The “Necessary Expense Doctrine”

# Comprehensive Health Care for NASA Employees

- ◆ Federal Employees Health Benefits Program – administered by the US Office of Personnel Management
  - Health
  - Vision
  - Dental
  - Flexible spending accounts
  - Long term care
- ◆ TRICARE
  - Department of Defense personnel detailed to NASA

# ***NASA Facilities and Clinics***

**18,500 Civil Service Employees Agency-Wide**

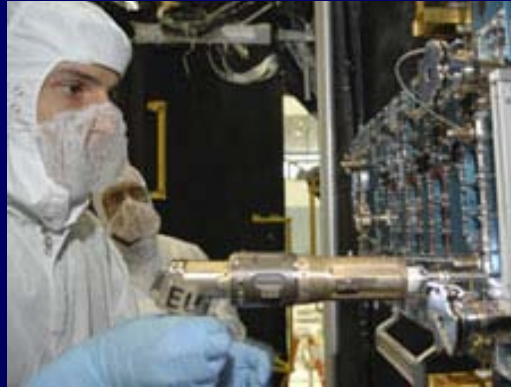


**Kennedy Space Center -  
NASA Principal Center  
for Occupational Health**

**Johnson Space Center –NASA  
Principal Center for Human  
Space Flight**

# ***NASA Occupational Exposures (Ground Based)***

- ◆ Noise
- ◆ Fuels
- ◆ Solvents
- ◆ Paints
- ◆ Pyrotechnics/explosives
- ◆ Pressure changes
- ◆ Closed spaces
- ◆ Office ergonomics
- ◆ Heat/cold
- ◆ Heights
- ◆ Radiation, etc.





# NASA Occupational Health Services (Ground Based)

## ◆ Occupational Medicine

- Emergency care
- Preventive health care
- Occupational health monitoring
- Limited treatment of occupational injury/illness

## ◆ Industrial Hygiene

## ◆ Employee Assistance Program

## ◆ Workers' Compensation Program



# NASA Occupational Health Clinics

NASA launch site uses DoD  
helicopters, ambulances and  
medical staff to cover visitors as  
well as the astronauts

# NASA Medical Launch and Landing Support (Space Shuttle)



# NASA Medical Launch and Landing Support (Space Shuttle)

KSC uses DOD helicopters and  
ambulances to cover visitors as  
well as the astronauts

# Stennis Space Center Clinic: Hurricane Katrina

## HURRICANE **KATRINA**

*T*he 2005 hurricane season will long be remembered both for the record-breaking number of early storms and the emergence of a powerful Category 5 hurricane in the central Gulf of Mexico—Hurricane Katrina.



Image was acquired by Terra's Advanced Very High Resolution Thermal Imager and Radiometer (AVHRR) Radiometer on April September 2005.



Image was acquired by Terra's Advanced Very High Resolution Thermal Imager and Radiometer (AVHRR) Radiometer on September 13, 2005.

Seventeen days after Katrina flooded New Orleans, much of the city is still under water. In this pair of images, the affected areas can clearly be seen. The flooded parts of the city appear dark blue, and the areas that have dried out appear light blue gray.

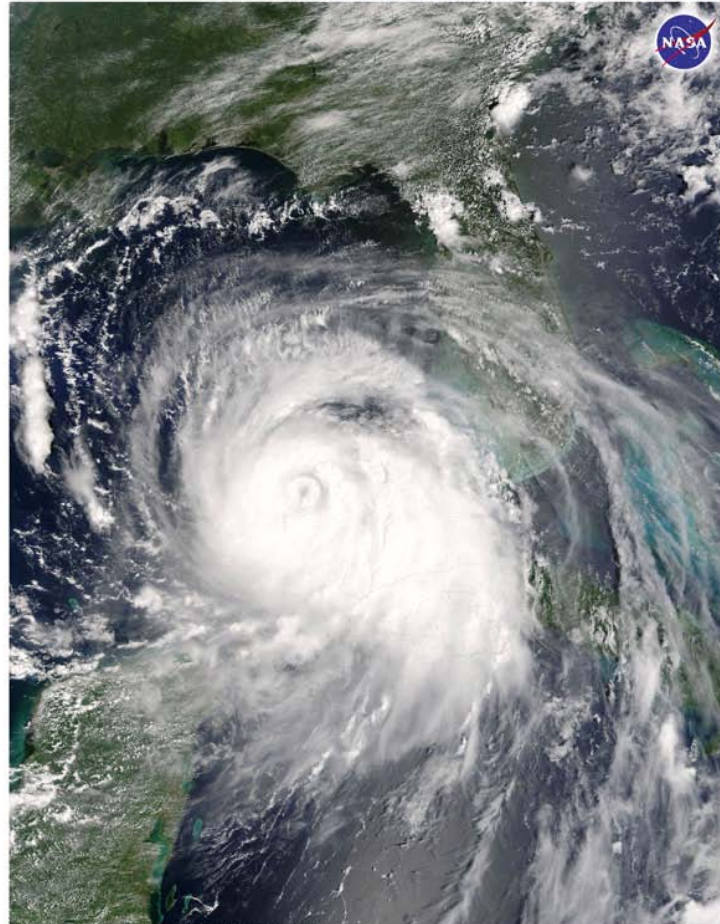


Image was acquired by Terra's Moderate Resolution Imaging Spectroradiometer (MODIS) sensor on August 28, 2005.

Hurricane Katrina strengthened into a powerful Category Five hurricane with sustained winds of 160 mph. The boost came just hours after Katrina reached Category 4, with wind of 145 mph, as it gathered energy from the warm water of the Gulf of Mexico. Here it continues on its path towards the Louisiana-Mississippi coastline.









































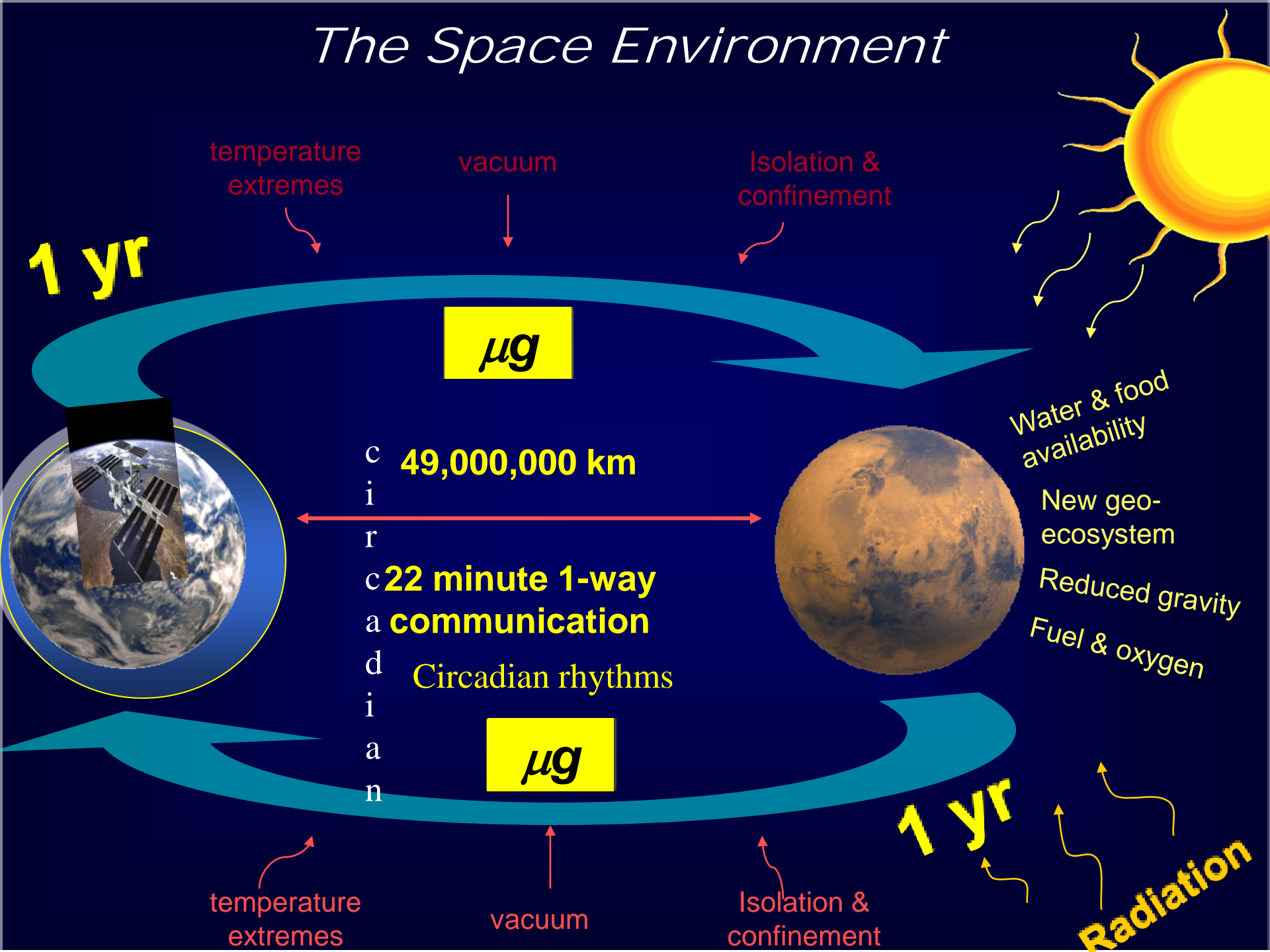




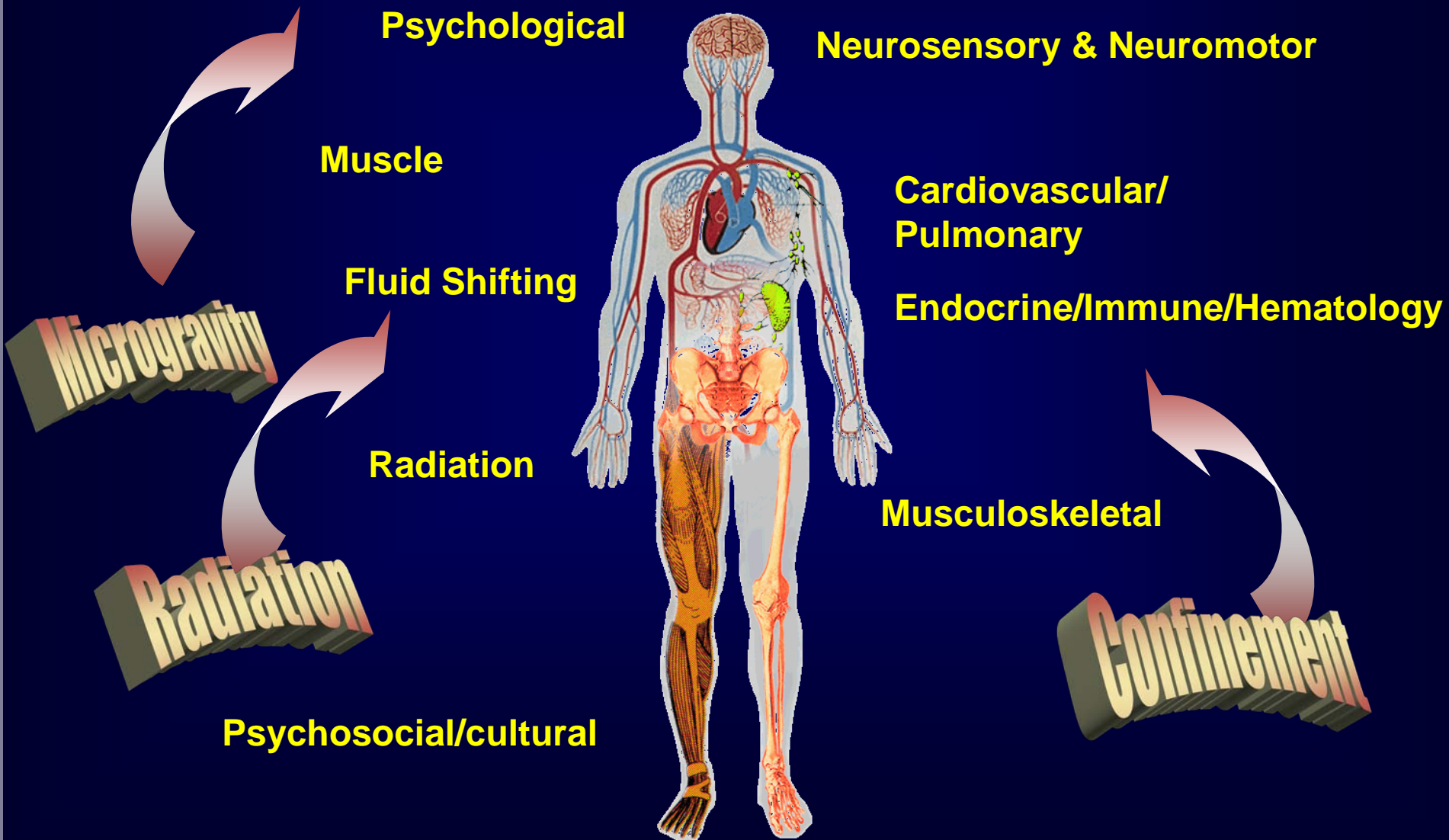




# The Space Environment



# *Physiology of Spaceflight*







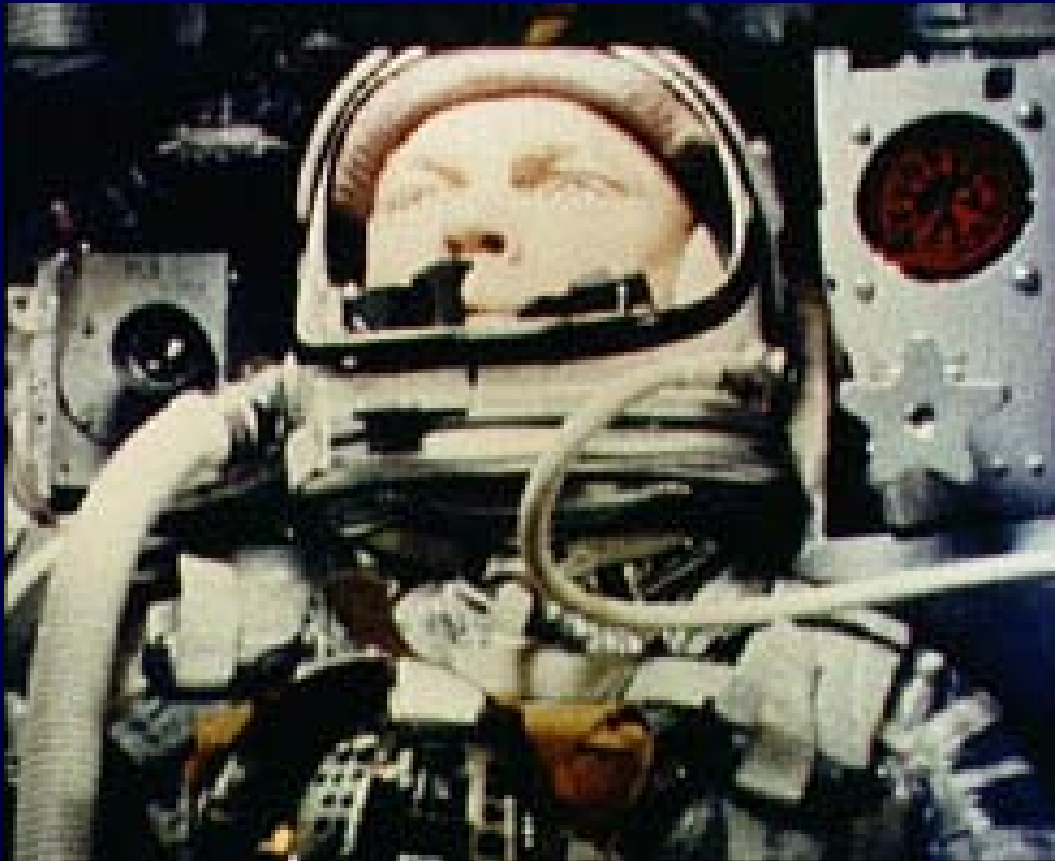




# Johnson Space Center Flight Medicine Clinic

- ◆ Comprehensive health care for astronauts on active duty with NASA and limited health care for their dependents (space available basis)
- ◆ Longitudinal Study of Astronaut Health for all astronauts, active and former
  - Annual executive physical with examinations targeted to space exposures
  - Records of all episodes of health care

# *Medical Care in Space: Telemedicine Based*







# ***Delivery of Medical Care in Microgravity and Space***





# *CPR in Space*

ISS004-E-8510 (11 March 2002) --- Astronaut Carl E. Walz, Expedition Four flight engineer, performs cardio-pulmonary resuscitation (CPR) on a jerry-rigged "human chest" dummy in the Destiny laboratory on the International Space Station (ISS).



ISS004E8510

ISS004-E-8504 (11 March 2002) --- Astronaut Daniel W. Bursch, Expedition Four flight engineer, performs cardio-pulmonary resuscitation (CPR) on a jerry-rigged "human chest" dummy in the Destiny laboratory on the International Space Station (ISS).



ISS004E8504



ISS004E8506

# Communications Challenges

**IMAGE  
DEGRADATION**

**INTERRUPTIONS**

**DELAY (>2 sec.)**

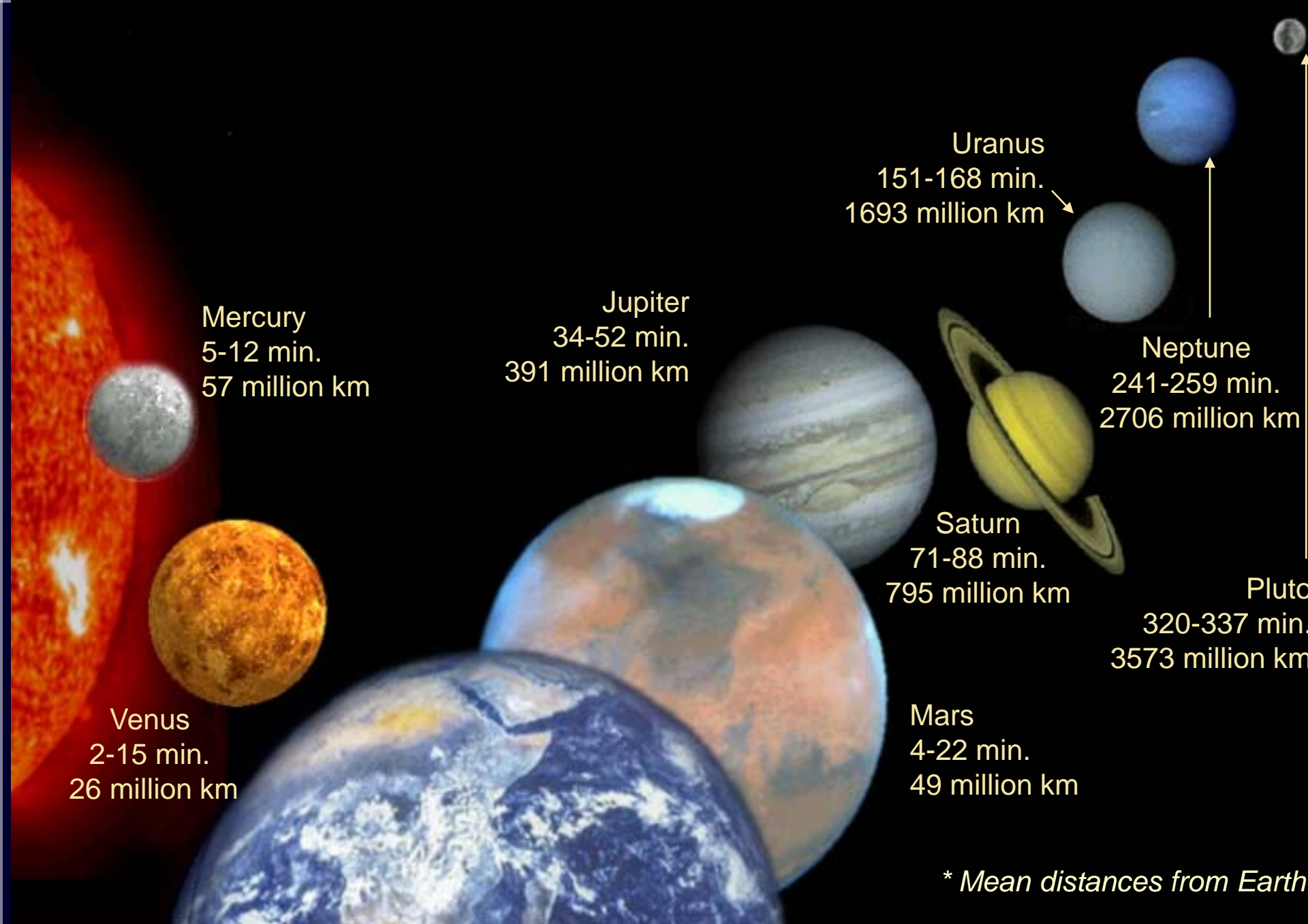


Voice  
Reference Files  
Procedures

Voice  
Real-time video (US)  
Real-time video (other?)  
Files (stills and cine)  
Recorded Video

**PRIVACY**





\* Mean distances from Earth



**Nanotechnology**

**Biotechnology**

**Self-replicating,  
self-repairing,  
& complex**

**Interconnected &  
autonomous**

**Smart &  
communicative**

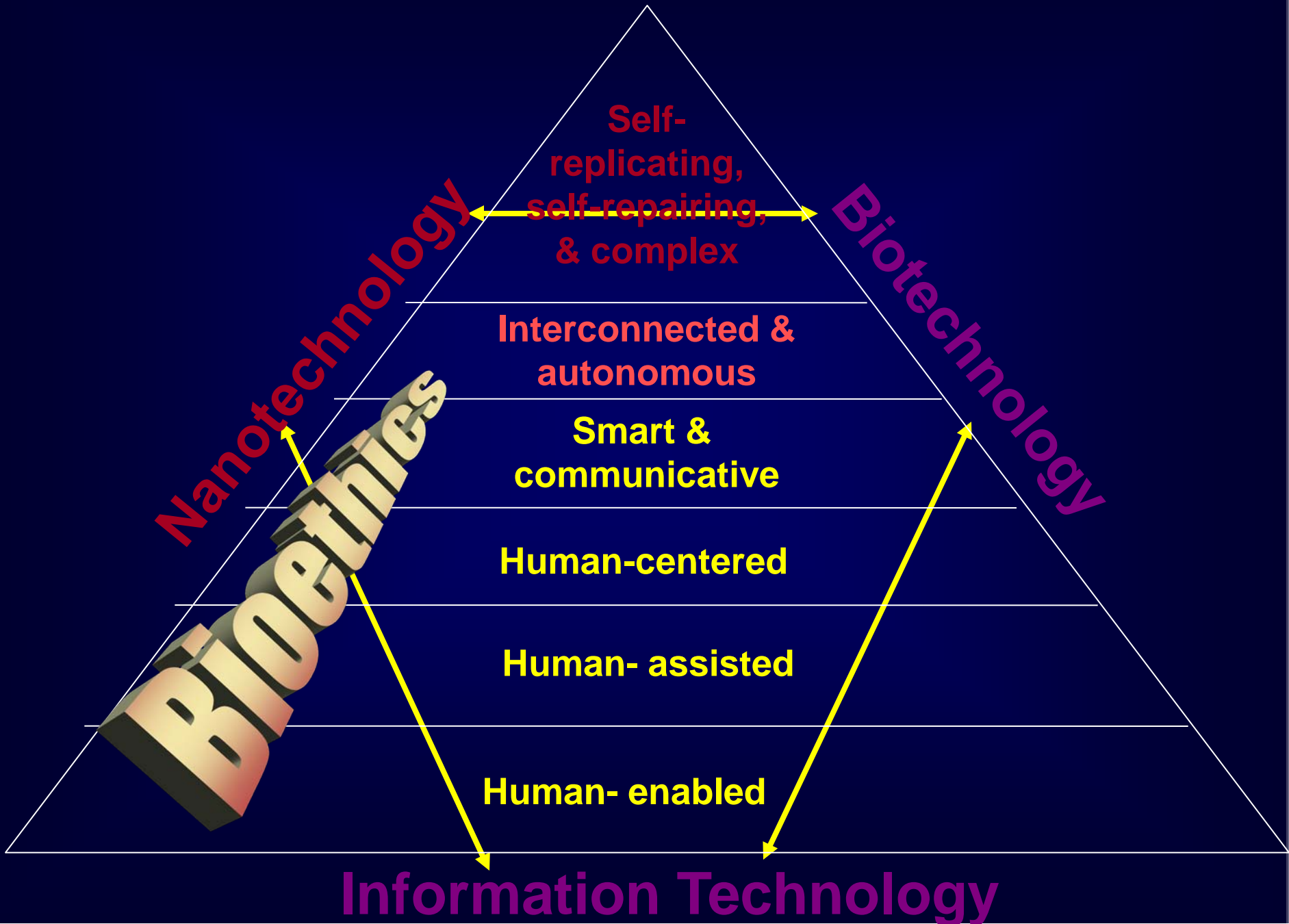
**Human-centered**

**Human- assisted**

**Human- enabled**

**Information Technology**

**Bioethics**



# *Future of Health Care in Space*

## **From telecare to autonomy**

Adaptive Automation

Multipurpose Tactile Interface

Biosensors for environmental and physiologic monitoring

Genetic profiling

Genetic diagnosis

Genetic vaccines

Tissue engineering

Biologically-Inspired Robots

Biotech based immunotherapy

Functionally-Adaptive Biomimetics

Nanomachines (self assembly)

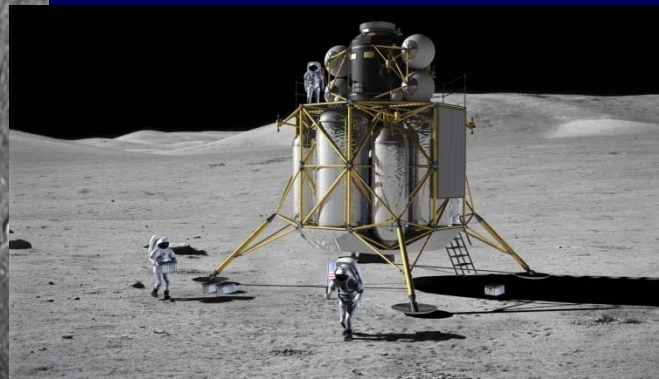
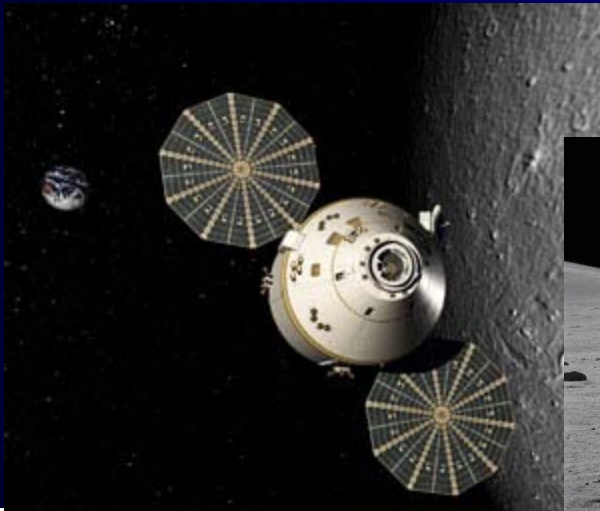
Cell herding, genetic surgery

Biologically based nanocomputers

Artificial intelligence

Smart/haptic systems

Virtual physician



# NASA On Site Medical Clinics

- ◆ NASA maintains on site occupational health clinics at all Centers and major facilities
- ◆ NASA maintains an on-site clinic that offers comprehensive health care to astronauts at the Johnson Space Center
- ◆ NASA deploys limited health care capability to space and extreme environments
- ◆ Focus is always on preventive health care



